OAK RIDGE BRIDGE
(Bridge No. 6052)
Spanning the Southern Railroad at Virginia State Route 653
Oak Ridge Vicinity
Nelson County
Virginia

HAER No. VA-107

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
Northeast Region
U.S. Custom House
200 Chestnut Street
Philadelphia, PA 19106

HISTORIC AMERICAN ENGINEERING RECORD
OAK RIDGE BRIDGE
(BRIDGE NO. 6052)

HAER NO. VA-107

LOCATION: Virginia State Route 653 over the Southern Railroad, Oak Ridge vicinity, Nelson County, Virginia.
USGS Shipman, VA Quadrangle, Universal Transverse Mercator Coordinates: 17.687570.4174220

DATE OF CONSTRUCTION: 1882

BUILDER: Keystone Bridge Company, Pittsburgh, Pennsylvania

PRESENT OWNER: Virginia Department of Transportation

SIGNIFICANCE: The Oak Ridge Bridge is a representative example of a pin-connected wrought iron Pratt through truss typical of late nineteenth century factory-manufactured railroad bridges. The bridge was moved to its present site to serve as an overhead highway bridge, a typical reuse of early railroad bridges. The bridge is an important contributing structure within the Oak Ridge historic district.

PROJECT INFORMATION: The Oak Ridge Bridge was recorded in 1993-1994 by the Cultural Resource Group of Louis Berger & Associates, Inc., Richmond, Virginia, for the Virginia Department of Transportation (VDOT). The recordation was undertaken pursuant to provisions of a Programmatic Memorandum of Agreement (Draft) among the Federal Highway Administration, VDOT, the Virginia SHPO, and the Advisory Council on Historic Preservation concerning management of historic metal truss bridges in Virginia. Project personnel included Richard M. Casella, Architectural Historian; Ingrid Wuebber, Historian; and Rob Tucher, Photographer.

DESCRIPTION

The Oak Ridge Bridge is a three-span structure, consisting of a pin-connected steel through truss and two steel and wood beam deck spans. The bridge carries a single lane of Virginia State Route 653 in a northwest-southeast direction over the tracks of the Southern Railroad, near Oak Ridge in Nelson County, Virginia (Figure 1). The immediate area around the bridge is open rolling farmland and pasture with widely spaced farm complexes and residences. Overall, the bridge is 137'8" long, consisting of the north deck span measuring 19'2", the center truss span measuring 100', and the south deck span measuring 18'6".

The truss is a Pratt type, with parallel chords, posts in compression, and diagonals in tension. All members of the truss are iron or steel, joined with pinned, riveted, or threaded connections. The truss is 21'8" high, 17' wide, and 100' long with six panels, each 16'6" wide (Figure 2).

Top chords and inclined endposts are riveted box sections, 14" x 10-5/8" overall, built with 14" x 3/16" top plate, 10" x 2-5/8" side channels with flanges turned out, and 2" x 5/16" single bar-lattice. The truss rides on fixed bed plate and plate and roller bearings, both types measuring 24" square. Bottom chords consist of paired die-forged eyebars of two sizes. The bottom chords of panels one and two (panels are counted in from each end) are continuous and measure 1" x 4". The third panel bottom chords measure 1-1/4" x 4".

The riveted box-section bar-lattice posts are 11" x 7-3/4" overall, made up of two 7" x 2" channels with flanges turned out, spaced 7" apart, and connected by single 2" x 3/8" bar-lattice on the top and bottom. Main diagonal panel braces consist of paired die-forged eyebars and measure 1-1/8" x 3" in panel two, and 5/8" x 3" in panel three. Adjustable counter diagonals are located in panel three and consist of 1-1/8" square loop-welded eyebars with upset threads and turnbuckles. Hip verticals consist of two 3/4" x 3" die-forged eyebars. Bottom chord pins are 4"; top chord pins are 3-3/8" except the endpost pins which are 3-7/8".

Portal struts are riveted I-section struts consisting of two 6" x 2" channels with flanges turned out. Portal braces are curved riveted T-sections consisting of two 3" x 2" angles. A circular brace of the same construction as the bracket is set in the spandrel formed by the bracket (Figure 3). Upper lateral struts are riveted I-sections consisting of two 5" x 1-1/2" channels with flanges turned out. Upper lateral bracing rods are 1", threaded at both ends, and connect with skewback brackets riveted to the strut end plates. There is no intermediate sway bracing.

The floor girders, are riveted I-section plate girders, 30" x 10" overall, constructed of 7/16" web plate and double 3" x 5" angle flanges. The girders are riveted with angles and plates directly to the posts which extend below the bottom chord pins 25". At the hip vertical, a 5/8" thick plate hangs from the pin and is riveted directly to the girder. A total of ten 6" x 14" wood floor stringers, spaced an average of 12" on center, rest on a 10" x 10" wood block which in

turn rests on the floor girder. Two steel stringers, consisting of 24" x 10" riveted I-section plate girders, spaced 8' apart are riveted to the girders but not fastened to the decking. Bottom lateral struts are located at each end of the bridge, riveted directly to the endpost pedestals. Bottom laterals consist of round loop-welded eyebars, measuring 1-3/4" in panel one, 1-1/4" in panel two, and 1" in panel three. The bracing rods attach with pins to double plate brackets riveted to the upper flange of the girder.

The steel and wood beam deck spans consist of nine wood stringers, 14" x 6", and four rolled steel I-beam stringers, 18" x 6". The steel stringers are paired and joined 11" on center with rivets, plates, and angles.

The bridge decking consists of 4" x 10" pressure-treated wood planks attached to the stringers with carriage bolts and deck clips. The roadway is 12'6" wide and edged with 4" x 6" wood curbing raised 2" off the decking. The bridge railings consist of two horizonal rows of 2" x 6" timber planks bolted to 4" x 6" timber posts.

The ends of the bridge rest on concrete abutments. The north abutment is straight, 18'8" wide, 2'7" deep, and approximately 2' high. The south abutment is a U-type, 18'8" wide, 8' high, and approximately 8' deep. The truss rests on two open concrete piers each consisting of two square columns with battered faces. The columns measure 3' square at the top and are spaced 16' apart on center. Both piers carry two 18" x 6" rolled I-beams which in turn carry the timber floor stringers of the deck spans. The south pier is approximately 27' high and filled to a height of 16' with a concrete web wall. The web wall serves as a retaining wall for the earth embankment behind, and as a footing for five 10" x 10" wood columns. The columns are cross braced with two 3" x 10" timbers. This feature is absent on the shorter north pier, suggesting that the structure reduces lateral strains on the columns. The north pier is an average of 8' high, due to its placement higher on the embankment.

HISTORICAL INFORMATION

Background

The Oak Ridge Bridge is believed to be the second bridge built to span the railroad cut on Virginia State Route 653. It occupies the site of a former bridge constructed between 1857 and 1860 to span the cut made by the Orange & Alexandria Railroad. The Oak Ridge Bridge was a former railroad bridge which was moved to its present site, probably in the early twentieth century. From the time of construction until the present, this bridge has been associated with the Oak Ridge Estate.

Robert Rives (1764-1845) built the original portion of the mansion at Oak Ridge circa 1802. Route 653 was probably laid out at that time to provide access to the Stage Road (presently State Routes 29 & 56). Rives acquired the property through his marriage to Margaret Jordan Cabell, whose father owned 30,000 acres along the James River. Rives made his fortune by controlling the entire tobacco trade along the upper James River. The Oak Ridge Plantation included flour, corn, wool, and cotton mills; sawmills; a tannery; a shoemaker's shop; a distillery; and a store (Rives 1992:41)

Robert and Margaret Rives' children, William Cabell Rives and Peggy Rives, were the owners of Oak Ridge when the Orange & Alexandria Railroad built its line through their property between 1857 and 1860. During his lifetime, William Cabell Rives (1792-1868) served as a Minister to France, a United States Senator and a member of the Confederate Congress. Commissioners were appointed by the Nelson County Court to determine an adequate compensation for the taking of more than 16 acres from Peggy Rives and more than 17 acres from William Cabell Rives for the Railroad's right of way. In addition, the Railroad took stone for use in its construction from Peggy Rives' property (Nelson County Deed Books 15:98, 192, 594).

The Orange & Alexandria Railroad had completed its main line from Gordonsville, in Orange County, to Alexandria in the period 1848 to 1854. A contemplated railroad line between Lynchburg, Virginia, and Bristol, Tennessee, made an extension of the Orange & Alexandria Railroad to Lynchburg desirable. The Lynchburg extension was completed in the period between 1853 and 1860 (Harrison 1901:455, 458). Stations were established near Oak Ridge at Nelson (present Shipman) and Arrington (Orange & Alexandria Railroad Company, Correspondence, Legal File, 1851-1867).

The Orange & Alexandria Railroad formed an important link in the "Great Southern & Southwestern Mail Route," which passed through Tennessee en route to New Orleans. By 1857, under John S. Barhour's leadership, the Orange & Alexandria Railroad grew from a ninety-seven-mile line capitalized at $457,000 to a 168-mile line with capital of $7.18 million. The Railroad's main line became a major traffic artery to the South and acquired additional connections in Virginia (Davis 1985:112).

During the Civil War, the railroads of northern Virginia, including the Orange & Alexandria, were among the most vulnerable in the South. The strategic location of these lines meant they were fought over with greater intensity and for longer periods than any other railroad lines. Confederate plans to carry all railroad equipment southward were thwarted on May 24, 1861, when Major (later General) William T. Sherman led the first Federal troops into Virginia and seized the Orange & Alexandria Railroad properties in Alexandria (Davis 1985:168-169).

The Miles family owned Oak Ridge from 1866 to 1901. In 1902 it became the home of Thomas Fortune Ryan (1851-1928), one of the country's richest men. When Ryan purchased the estate, it consisted of 1,067 acres. He continued to acquire surrounding property until Oak Ridge included nearly 5,000 acres of land.

During his tenure, as many as one hundred and eighty people worked on the estate. It was a self-sufficient community with its own post office, dairy, blacksmith shop, carpenter shop, machine shop, power plant, 240,000 gallon reservoir, and telephone system. Wages were considered to be high and Ryan furnished his employees with milk from the dairy and land for a garden. The estate included a store, primary school, and a Catholic chapel (St. Mary's). Every third Sunday a priest from Holy Cross Church in Lynchburg would hold services at the chapel which is located next to the Oak Ridge Bridge (Brandt 1987:D1-2; Madison 1991:B1; Rives 1992:41).

Ryan even established his own railroad station on the Southern Railway, where he kept a personal railroad car ready to leave at a moment's notice. Upon his death in 1928, Ryan was estimated to have been worth $126 million (Rives 1992:39-41). During the period Thomas Fortune Ryan and later his widow lived at Oak Ridge, 4000 acres of the estate was farmed. Descendants of Thomas Fortune Ryan continued to own Oak Ridge until its sale to John and Rhonda Holland in 1989 (Oak Ridge Vertical File).

History of Oak Ridge Bridge

The Orange & Alexandria Railroad, as with many of the southern railroads, was consolidated and reorganized several times during Reconstruction. In 1881 it became the Virginia Midland Railway. The Railway expended a great amount of its capital on construction, equipment, and rolling stock during the period leading up to the Oak Ridge Bridge's construction in 1882. One of its biggest expenditures was the construction of iron bridges over the Rappahannock River and over the James River at Lynchburg. Many of the small bridges and trestles received extensive repairs, and fifteen bridges along the main line were slated for replacement by iron bridges. The Oak Ridge Bridge was built by the Keystone Bridge Company in 1882 and located somewhere along the line as a railroad bridge (Virginia Midland Railway Company, Engineer & Superintendents Reports, 1883-1884; Stockholders and Directors Minutes, 1881-1897:157). In 1894 the Virginia Midland was consolidated into the Southern Railway system which is the current operator of the line (Harrison 1901:453-454).

Between 1901 and 1905 the Southern Railway double-tracked its line between Alexandria and Orange. The project included the replacement of all old bridges with new higher capacity bridges built by the Phoenix Bridge Company of Phoenixville, Pennsylvania. Four of the original single-span, single-track through trusses were reused as overhead highway crossings, erected by

Southern Railway personnel. It is likely that the Oak Ridge Bridge was erected during this period, or shortly after, when improvements were continued along the line south of Orange (Ash 1905:213-215).

Thomas Pratt and the Pratt Truss

Thomas Pratt was born in Boston in 1812, entered Rensselaer Polytechnic Institute at age 14, became an engineer with the United States Army Engineers at 18, and began a professional engineering career with Boston & Maine Railroad at age 21. Pratt worked his entire life in the employ of various New England railroad companies (American Society of Civil Engineers [ASCE] 1876:332-333; Condit 1960:108).

Pratt is famous for a bridge truss that be designed in 1842 that consisted of two parallel chords connected by vertical wood posts in compression and double wrought iron diagonals in tension. Pratt's design was similar in appearance to an earlier truss patented by William Howe, but structurally opposite in that Howe's design put the verticals in tension and the diagonals in compression. The Pratt truss is considered to be the first scientifically designed truss, incorporating what are now considered basic structural engineering principles (Condit 1960:109). Pratt used shorter compression members, allowing members of smaller cross section to be used without sacrificing overall strength. This innovation provided a lighter truss requiring less materials, yet offered greater span and load bearing capability than the other truss designs of the time.

In 1844, Pratt was granted a patent for two truss designs, one with parallel chords, and one with a polygonal top chord. The polygonal version reflected Pratt's understanding of the application of mathematical principles in calculating the forces involved and tbe precise strength of material required to counter those forces. Pratt's patent was renewed in 1858. The use of the Pratt truss for the deck of John Roebling's Niagara River Suspension Bridge in 1855 drew worldwide attention to the design and undoubtedly contributed to its increased use. By 1889, the truss in its iron form ranked first in usage for railroad bridges. Thousands of bridges, both highway and railroad, have been built following the Pratt design or some variation (ASCE 1876:334-335; Condit 1960:111, 112, 302; Cooper 1889:11; Johnson 1929:179).

The Keystone Bridge Company, Pittsburgh, Pennsylvania

The Keystone Bridge Company was formed in 1865, taking over the operation of the Shiffler and Piper Bridge Works of Pittsburgh. Among the first officers and directors were Aaron Shiffler, J.L. Piper, Andrew Carnegie, and Walter Katte'. A stock offering in 1872 provided capital for a major expansion of the factory, and it was probably at this time that Shiffler left

to form Shiffler Bridge Company. In 1874, J.H. Linville, one of the leading bridge engineers, assumed the Presidency of Keystone, and Walter Katte', also an engineer, opened the western office in St. Louis. Andrew Carnegie built the Union Iron Mills adjacent to the Keystone plant to supply the structural steel, and later purchased Keystone, making it a subsidiary of his Carnegie Steel Company (Keystone Bridge Company 1874:7, 8; United States Steel Corporation 1975:8, 13).

Keystone Bridge Company attracted the best engineers and invested heavily in research, development and testing. The firm significantly advanced the science of bridge building, evidenced by their many bridges of record setting length or load capacity. The Ohio River Bridge at Stubenville (1863-1864) is considered the beginning of long span metal truss bridge building in America; the 519' Cincinnati Southern Railroad bridge over the Ohio (1876) was the longest truss span at the time. The company was also known for it patented Keystone Column, similar to the Phoenix Column, and for its hydraulic testing machines which provided test data for early specifications for steel bridge members (Cooper 1889:17, 20; Tyrrell 1911:173, 180).

In 1901, the Keystone Bridge Company was purchased by the newly formed American Bridge Company, created in 1900 and 1901 by J.P. Morgan as a consolidation of twenty-eight bridge companies representing eighty percent of the structural steel fabricating capacity of the United States. At that time, the Keystone Bridge Company had a manufacturing capacity of 32,500 tons of structural steel per year and employed 1,000 men, putting it among the largest of the twenty-eight companies purchased by the American Bridge Company. Three other Pittsburgh area bridge firms, Shiffler Bridge Company, Schultz Bridge and Iron Company, and the Pittsburgh Bridge Company were also purchased, giving the American Bridge Company a total production capacity in the Pittsburgh area of over 90,000 tons per year (*Railroad Gazette,* 1902:172; United States Steel Corporation 1975:7, 8).

In 1902, the American Bridge Company began construction of a huge new plant outside Pittsburgh near the town of Economy, alongside the Ohio River and the Pennsylvania Railroad's Main Line west of Pittsburgh. The plant combined the Pittsburgh plants mentioned, and included a large upland tract for residential development which eventually became the new town of Ambridge. This facility was the largest of its kind in the world with a capacity of 240,000 tons per year. The scale of the operation is appreciated by the drafting department alone which accommodated 500 draftsmen. In 1904, the headquarters of the American Bridge Company was moved from New York to Pittsburgh (*Engineering News* 1902:527-528; United States Steel Corporation 1975:7).

According to *A Survey and Photographic Inventory of Metal Truss Bridges in Virginia, 1865-1932*, a study conducted by the VDOT Research Council in 1973, the Keystone Bridge Company built one other metal truss bridge in Virginia, VDOT Bridge No. 6047 in Prince William County, also one of the seventeen historic metal truss bridges recorded by Virginia in 1993-1994 of which this report is a part (Deibler 1973).

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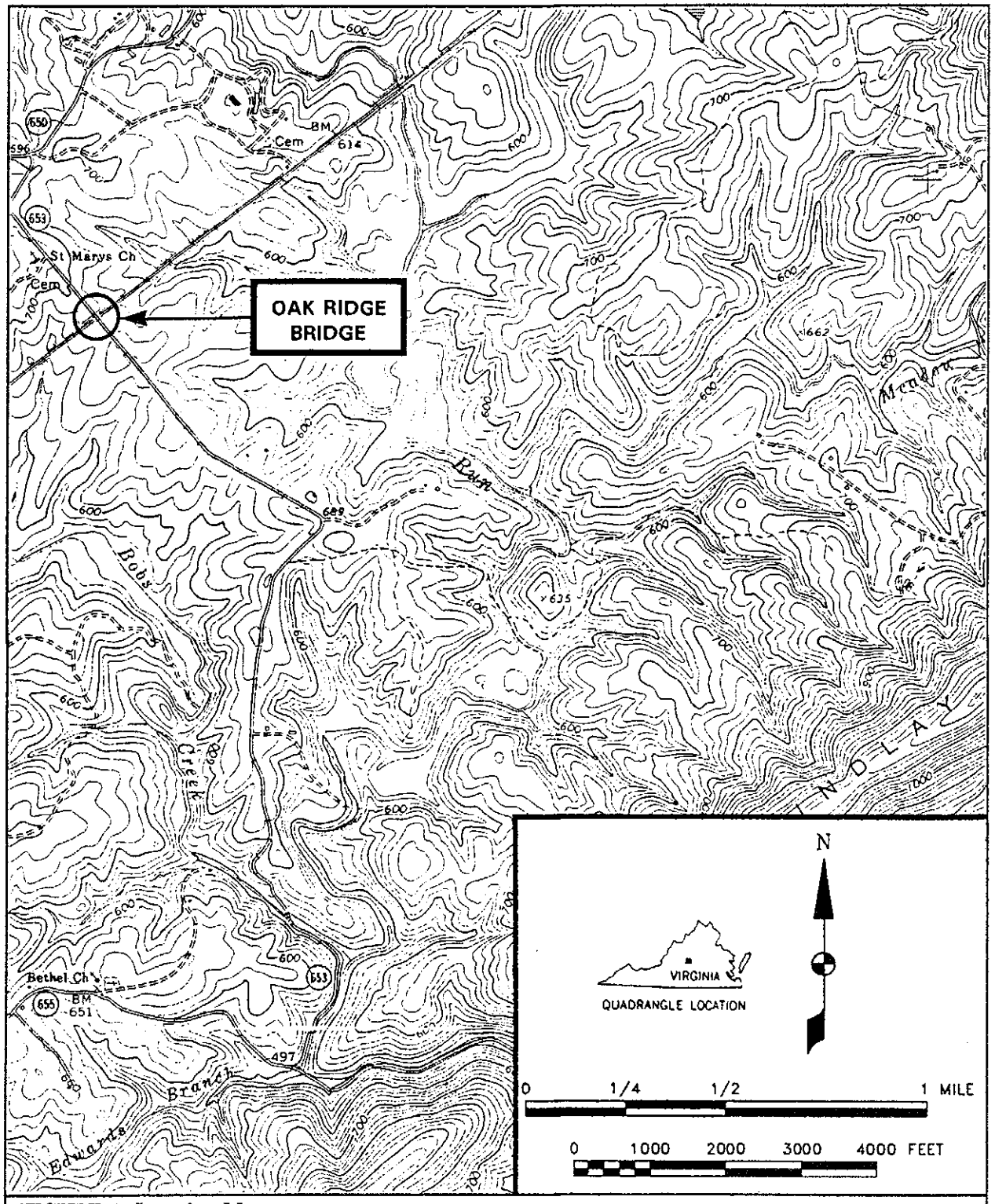

FIGURE 1: Location Map

SOURCE: USGS 7.5 Minute Quadrangle, Shipman, VA, 1969 (Photorevised 1987)

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FIGURE 2: Original Bridge report, Bridge No. 6052, October 11, 1974 *SOURCE: Virginia Department of Transportation 1974*

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SOURCE: Virginia Department of Transportation 1974

FIGURE 3: Original Bridge report, Bridge No. 6052, October 11, 1974